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POTATO SEED TREATMENT EXPERIMENTS ON LONG ISLAND WITH SPECIAL REFERENCE TO THE ORGANIC MERCURY INSTANT DIPS

E. E. CLAYTON

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BULLETIN NO. 564

POTATO SEED TREATMENT EXPERIMENTS ON LONG ISLAND WITH SPECIAL REFERENCE TO THE ORGANIC MERCURY INSTANT DIPS

E. E. CLAYTON

ABSTRACT

The experiments here reported were conducted during the seasons of 1925, 1926, 1927, and 1928, under field conditions with (1) the most healthy seed that could be secured, (2) ordinary grades of commercial certified seed, (3) scabby seed, (4) black scurf infected seed, (5) black-leg infected seed, and (6) blight infected seed.

The organic mercury compounds were used as dusts, soaks, and instant dips. The chief ones were Semesan Bel and Bayer Dipdust.

The experiments consisted of tests at the Long Island Vegetable Research Farm, where plats were 50 to 70 feet long and treatments replicated 5 to 12 times; and tests with growers, these latter being conducted under usual field conditions with plats varying in size from an eighth to a half acre and with two to three replications.

The organic mercury treatments increased yields slightly as compared with no treatment or mercuric chloride treatment. The mercuric chloride treated seed in some experiments yielded less than untreated seed.

The organic mercurials controlled seed-borne scab infection about as well as mercuric chloride but were less effective against black scurf.

The efficiency of seed treatments against black-leg could not be determined since, in two successive years, the planting of potatoes produced in black-leg diseased hills gave crops that were practically 100 per cent healthy.

Seed treatment was of value in protecting against seed piece decay and the weak plants or skips that are the result of this.

Tested out with many farmers under actual growing conditions, neither the organic mercury instant dip nor the mercuric chloride soak treatments have been profitable often enough to justify the added expense and bother of treating.

The reasons for this appear to be that the seed planted in the Long Island section is the best certified seed obtainable and hence carries a minimum of seed-borne disease, and that the fields used

have been growing potatoes continuously for many years with the result that they are generally scab and scurf infected. The control of these diseases in consequence is a soil and not a seed problem. Protection of seed pieces against decay does not justify regular treatment because the need is too infrequent. The tendency of the organic mercurials to increase yields has not proved of great practical value for the average increase in yield secured by 28 farmers in 1928 was only a little over 2 per cent.

INTRODUCTION

The value of treating seed potatoes before planting is regarded as an established fact in practically every potato-producing section of this country. On Long Island, however, there is a highly developed potato industry manned by growers who utilize the most up-to-date practices and who have not considered it profitable to treat their seed. Furthermore, demonstrations of the value of seed treatment, conducted on Long Island by the extension department of the agricultural college, have, in many cases, yielded negative results.

In consequence of this situation the present study was undertaken to determine whether in this district seed treatment was, on the average, profitable. The growers for their part have insisted that no seed treatment recommendation such as the 1½ hour soak in mercuric chloride solution could ever be used because of its slowness and they asked that we secure information about the newly developed organic mercury instant dip treatments. To answer these questions, it was decided to compare the instant dip and dust treatments with (a) no treatment and (b) the standard mercuric chloride treatment. The growers were interested in the effect of treatment on the yield of marketable potatoes and consequently marketable yields were accepted as the standard by which results were to be measured, with supplementary attention given to various diseases.

LITERATURE REVIEW

In 1891 Bolley (4)[1] recommended the use of mercuric chloride as a potato seed treatment, and in 1897 Arthur (2) brought forward formaldehyde. During the years that followed, Gloyer (10) and others demonstrated that mercuric chloride was more effective against rhizoctonia than formaldehyde, and at the present time

[1]Refers to Literature Cited, page 31.

the 1½ hour soak in 0.1 per cent mercuric chloride is a standard process for potato seed treatment in most of the eastern states, including New York. The development of the hot formaldehyde method by Melhus and Gilman (14) resulted in the renewed use of formaldehyde and this, employed in the new way, proved highly effective against both scab and rhizoctonia. In 1925 Chupp (7, page 378) states that hot corrosive sublimate has been substituted in some localities for the hot formaldehyde and has proved the most effective disinfectant yet suggested.

Recently there have appeared the organic mercury instant dip treatments which have the advantage of being applied cold and hence can be used by any farmer without the special heating equipment required for the hot formaldehyde or the prolonged time required for the cold mercuric chloride, but there has been some controversy regarding their effectiveness. Thus Martin (12) recommends the new dip treatments equally with the older methods for New Jersey, while Goss and Werner (11) state that none of the organic mercury preparations controlled scab sufficiently to warrant their use in Nebraska.

It is a fact that a careful study of the numerous reports of experimental work show many conflicting data and at no time since potato seed treatment was originally suggested has there been greater diversity of recommendations than at present. However, all responsible agencies in the United States recommend some form of potato seed treatment as profitable.

In most parts of Europe, where potatoes have been longer and more extensively cultivated than in this country, potato seed treatment is not a general practice. Schlumberger (18), working in Germany, found scab prevalent in the soils and seed treatment was of little value. Schander and Richter (17), working with rhizoctonia, report that seed treatment neither increased the yield nor decreased the amount of disease. In Holland, however, Dorst (9) reports that mercuric chloride seed treatment was profitable against rhizoctonia even tho soil infection was common.

PROCEDURE

The treatment methods used in this work were as follows: With the dry dusts, the tubers and disinfectant were placed inside a smooth, strong barrel having a tight lid and this was rolled for two or three minutes. The covering secured was good and there was

little or no bruising of the tubers. Obviously, this sort of treatment would not be used on sprouted or freshly dug potatoes. The instant dip organic mercurials, Bayer Dipdust and Semesan Bel, were made up with water in 5 and 10 per cent suspensions. The mercury carrier used in Semesan was such that it mixed readily with water, but the colloidal clay carrier used in Bayer Dipdust required long soaking or else prolonged mixing to get it into suspension. The procedure followed was to mix the powders one day and apply two or three days later, stirring thoroly before using. Where potatoes are to be treated on a large scale these preparations are made up in sufficient quantity so that the tubers can be dipped a bushel at a time. With the small lots used in this work it was necessary to treat the tubers in shallow piles with a sprinkling can or compressed air sprayer. A large surplus of liquid was applied and the potatoes turned over and over until all surfaces were thoroly wet. The wet tubers were bagged at once, and cut the following day. The treatments were safe enough so that there was no need for immediate drying of treated stock. In one case potatoes were placed in a tight barrel immediately after treatment and held for a month. They showed some mold when taken out, but grew perfectly.

Mercuric chloride was used at 1 to 1,000 strength for 1½ hours soaking, and the potatoes were dried at once and cut.

The seed lots used were selected for uniformity and the seed pieces were as uniformly 1½ ounces as it was possible to cut them. All planting was done by hand and a marked planting line used to insure even spacing. Fertilization, cultivation, and spraying, suitable for optimum growth, were given all plats and the yields secured each year have been good, varying from 200 to 350 bushels per acre. The plats were so arranged, with intervals between, that it was possible to dig by machine. Each lot as picked up was bagged and tagged and all were held until the records were complete. Only potatoes of marketable size were considered in taking data.

Counts of stand and of plants showing degeneration diseases were made in all experiments. Percentage stand figures are given only for those experiments where these differences were related to the seed treatment procedure. The percentage of the plants showing mosaics or leaf roll was very low in all experiments except one, and the results of this experiment were discarded. The seed used was in all instances of certification standard except for the scab, rhizoctonia, black-leg, or blight infection.

The analyses given by the manufacturers for the organic mercurials which they very kindly supplied are as follows: Bayer Dust (6 per cent hydroxymercurinitrophenol sulfate), Bayer Dipdust (6 per cent hydroxymercurinitrophenol sulfate and 2 per cent hydroxymercurichlorophenol sulfate), Semesan Bel (10 per cent hydroxymercurichlorophenol sulfate), and Semesan Jr. (10 per cent hydroxymercurichlorophenol sulfate). With regard to the Semesan preparations the mercury salt of the Semesan Jr. and Semesan Bel mixtures was in an insoluble form and in Semesan it was soluble. It may be noted that the Semesan Bel on the market for 1929 is of the same composition as the Bayer Dipdust used in these experiments.

EXPERIMENTAL

EXPERIMENT 1, 1925

Green Mountain seed was used in this experiment, and the tubers were severely scabbed but otherwise sound. The potatoes were treated April 1 as follows:

Mercuric chloride, 0.1 per cent for 1½ hours soak
Bayer dust, 5 ounces per 100 pounds of whole tubers
Semesan Jr., 3 ounces per 100 pounds of whole tubers
No treatment

The potatoes were cut the same day they were treated and were planted April 4. The plat rows were 100 feet long, and each treatment and each check was represented in 10 replications.

The weather for some weeks after planting was very dry and the "come up" in the plats and thruout the entire district was very uneven. The dusted seed came up first and made a vigorous uniform stand. The mercuric chloride treated seed sprouted more slowly and early growth was distinctly retarded. The untreated seed came up unevenly with many skips and weak plants. Examinations were made of a large number of hills which failed to show sprouts and it was found that the seed pieces in the weak and missing hills of the untreated seed plats were decayed. Burrowing thru the decayed tissues were numerous larvae of the seed corn maggot. The decay started from the cut surfaces in every case; and since there was practically no decay or maggots attacking the seed pieces that had been treated, the treatments applied to tubers before cutting evidently protected the cut surfaces as well as the surfaces to which they were applied.

TABLE 1.—EFFECT OF SEED TREATMENT ON SEED DECAY, TOTAL YIELDS, AND SCAB CONTROL IN GREEN MOUNTAIN POTATOES, 1925.

PLAT NO.	NUMBER OF HILLS			WEIGHT IN POUNDS		PERCENTAGE OF GRADE 1 WITH*		
	Strong	Weak	Missing	Grade 1	Grade 2	Clean	Slight scab	Moderate scab
				Untreated				
1	42	16	25	30.5	6.5	66.4	28.5	5.1
5	38	9	36	29.3	9.3	51.8	29.1	19.1
9	19	18	46	18.5	6.0	47.8	38.8	13.4
13	35	10	38	28.0	8.0	70.5	19.7	9.8
17	26	11	46	22.5	7.5	71.9	20.2	7.9
21	40	10	33	24.8	7.0	73.3	16.8	9.9
25	29	11	43	29.0	7.8	72.3	14.3	13.4
29	39	13	31	24.3	6.3	58.4	24.7	16.9
33	38	10	35	25.8	7.3	43.3	28.7	27.8
37	27	15	41	26.3	6.8	79.6	12.9	7.5
Ave.	33.3	12.3	37.4	25.9	7.3	64.2	23.0	12.8
				Bayer Dust				
3	77	4	2	62.5	10.3	93.9	3.1	3.0
7	78	2	3	68.3	12.0	87.2	10.8	2.0
11	68	9	6	61.0	10.8	85.3	12.6	2.1
15	72	5	6	52.8	13.8	89.4	5.8	4.8
19	66	10	7	52.5	10.5	88.6	8.9	2.5
23	65	5	13	51.0	13.5	90.0	8.0	2.0
27	67	7	9	60.3	13.5	89.0	7.5	3.5
31	77	1	5	65.5	14.0	84.5	13.8	1.7
35	79	3	1	74.0	12.5	86.4	9.3	4.3
39	78	1	4	74.8	13.8	88.9	7.4	3.7
Ave.	72.7	4.7	5.6	62.3	12.5	88.2	8.8	3.0
				Mercuric Chloride				
2	66	9	8	56.0	12.0	97.6	1.9	0.4
6	62	7	14	54.8	10.5	97.9	2.1	0.0
10	62	12	9	47.0	14.0	90.6	9.4	0.0
14	61	9	13	44.8	12.3	90.1	7.7	2.2
18	70	6	7	35.5	11.8	94.3	5.2	0.5
22	65	6	12	54.0	12.5	94.6	3.9	1.5
26	60	8	15	51.3	15.0	88.0	11.0	1.0
30	71	4	8	58.5	14.5	89.5	9.6	0.9
34	71	5	7	64.5	12.5	93.6	6.4	0.0
38	75	3	5	67.8	8.8	92.9	7.1	0.0
Ave.	67.7	6.9	9.8	53.4	12.4	92.9	6.4	0.7
				Semesan, Jr.				
4	80	1	2	74.3	12.0	88.4	8.3	3.3
8	78	2	3	69.3	13.0	78.6	15.5	5.9
12	76	5	2	58.5	14.5	88.0	9.1	2.9
16	72	6	5	62.5	13.8	87.9	6.3	5.8
20	75	2	6	63.8	13.0	87.5	9.4	3.1
24	78	4	1	73.3	12.5	85.7	8.3	6.0
28	72	3	8	60.3	12.5	82.9	13.2	3.9
32	78	2	3	59.5	11.5	80.6	11.8	7.6
36	81	1	1	70.5	12.0	81.5	10.6	6.9
40	76	4	3	73.0	14.3	82.6	13.6	3.8
Ave.	76.6	3.0	3.4	66.5	12.9	84.4	10.6	5.0

*Slight scab averaged 1 to 4 lesions per tuber and moderate scab 5 to 10 lesions. These two grades were mostly salable. Potatoes with badly corked, coalescing lesions were treated as severely scabbed.

The counts given in Table 1 show that Semesan Jr., dusted seed gave the highest percentage of vigorous plants, with the Bayer dust a close second, and the mercuric chloride soak third. All were very much superior to the check. The yield data follow the same order with Semesan Jr., highest and no treatment lowest. The scab data show that all treatments reduced the amount of disease, but that mercuric chloride was most effective and Semesan Jr., least effective. The potatoes were graded into firsts and seconds, but as there was really no gain from this practice it was discontinued in the later experiments.

EXPERIMENT 2, 1925

This test was conducted in cooperation with the State Institute of Applied Agriculture at Farmingdale, and the seed used was an exceptionally healthy lot of Maine certified Cobblers. The potatoes were treated on April 18 as follows:

Mercuric chloride
Semesan, soaking the tubers 1½ hours in a 0.25 per cent solution
No treatment

The lots were planted April 29 and 30, and thru the growing season there were no noticeable differences. In the fall the plats were dug and the potatoes graded. The data are given in Table 2.

TABLE 2.—COMPARISON IN POUNDS PER PLAT OF MERCURIC CHLORIDE AND SEMESAN SOAKING TREATMENTS USING HEALTHY IRISH COBBLER SEED, 1925.

PLAT No.	NO TREATMENT		MERCURIC CHLORIDE		SEMESAN		NO TREATMENT	
	Grade 1	Culls	Grade 1	Culls	Grade 1	Culls	Grade 1	Culls
1	77.0	30.0	62.0	34.5	77.0	33.5	80.5	43.5
2	65.5	39.0	62.5	31.5	78.5	37.5	61.5	41.0
3	57.5	42.0	59.0	27.0	76.0	32.0	55.0	33.5
4	66.3	54.5	79.5	32.5	84.3	35.5	56.5	37.5
5	79.5	33.0	73.5	29.5	76.5	34.5	61.5	37.0
6	69.5	35.0	74.5	28.0	76.5	32.5	64.0	31.5
7	58.0	37.5	53.0	26.5	72.0	33.5	50.0	32.5
8	60.0	38.5	71.5	26.5	77.0	29.5	65.5	34.5
9	71.0	34.0	78.0	29.5	91.5	27.5	72.0	28.0
10	74.0	28.0	84.5	32.5	91.0	23.0	78.0	32.0
11	66.5	42.5	68.5	27.5	84.0	24.5	79.0	28.0
12	74.0	34.0	75.0	23.5	80.5	31.5	64.5	32.5
13	58.5	28.0	74.5	28.5	73.5	30.5	56.5	33.0
Total	877.8	476.0	916.0	377.5	1038.3	405.5	844.5	444.5
Ave.	67.5	36.6	70.5	29.0	79.8	31.2	64.2	34.2

There was very little scab or rhizoctonia showing on the crop and consequently no counts of these were taken. The averages indicate a slight increase in yield for the use of mercuric chloride treatment and a distinct increase for the Semesan treatment.

EXPERIMENT 3, 1926

The seed used was a mixture of Cobblers as follows: One-half very scabby New Jersey stock, one-fourth equally scabby from Prince Edward Island, and one-fourth from a Maine field that showed much black-leg. Each treatment was represented by a 40-pound lot, and on April 6 treatments were used as follows:

Bayer dust, 2 ounces per bushel, whole tubers
Semesan Bel dust, 2 ounces per bushel, whole tubers
Semesan Bel, 10 per cent water suspension, instant treatment, whole tubers
Semesan Bel, 5 per cent water suspension, instant treatment, whole tubers
Semesan Bel, 10 per cent water suspension, instant treatment, freshly cut tubers
Semesan Bel, 5 per cent water suspension, instant treatment, freshly cut tubers
Mercuric chloride
No treatment

The potatoes, except lots 5 and 6, were cut the day after they were treated and were planted on April 12. The plat rows were 70 feet long, with 6 replications of each treatment and 12 checks.

The summarized figures of Tables 3 and 4 show that the organic mercurials reduced the amount of scab as compared with untreated seed, but they were not so effective in this respect as the mercuric chloride treatment. However, the seed planted was very scabby and the crop, even where seed was untreated, was fairly clean. This is due to the fact that Long Island soils are naturally acid, averaging less than pH 5. The freshly broken land is limed lightly, but once the land is devoted to potato growing it is never limed again. With the reaction 5.2 or below, as is usually the case, even tho the soil and the tubers planted be badly infected by scab, the crop produced is practically clean.

It appears that the 10 per cent Semesan Bel reduced the yield somewhat, while the other treatments gave small increases. There was no decay of seed pieces and the stand in all plats was practically perfect. There was no black-leg.

Table 3.—Effect on Yield of Treating Scabby Irish Cobbler Seed, 1926.

Treatment	Plat 1		Plat 2		Plat 3		Plat 4		Plat 5		Plat 6		Total		Average per plat	
	Lbs.	Ozs.	Lbs.	Ozs.	Lbs.	Ozs.	Lbs.	Ozs.	Lbs.	Ozs.	Lbs.	Ozs.	Lbs.	Ozs.	Lbs.	Ozs.
Bayer dust.....	59	0	60	4	68	0	62	0	58	12	48	12	356	12	59	7.3
Semesan Bel dust.....	66	4	63	0	60	4	64	6	48	0	51	10	353	8	58	14.7
Semesan Bel dip 10 per cent...	57	12	53	8	58	0	65	10	50	2	50	8	335	8	55	14.7
Semesan Bel dip 5 per cent....	57	8	60	4	58	12	67	8	57	0	49	4	350	4	58	6.0
Semesan Bel dip 10 per cent...	48	8	51	8	70	0	56	0	48	4	52	4	326	8	54	6.7
Semesan Bel dip 5 per cent....	46	4	58	0	65	4	60	0	48	12	51	0	349	4	58	3.3
Mercuric chloride.....	56	12	58	0	59	8	62	8	55	8	51	8	343	12	57	4.7
None.....	56	8	58	8	61	0	61	0	61	8	42	2	—	—	—	—
None.....	65	8	65	0	48	8	52	8	56	0	46	12	675	14	56	5.2

TABLE 4.—EFFECT ON PERCENTAGE OF SCAB OF TREATING SCABBY IRISH COBBLER SEED, 1926.

TREATMENT	PLAT 1	PLAT 2	PLAT 3	PLAT 4	PLAT 5	PLAT 6	AVERAGE
Bayer dust.....	9.3	4.6	10.4	3.6	3.4	2.8	5.9
Semesan Bel dust	4.5	2.6	7.5	5.0	3.3	2.7	4.3
Semesan Bel dip, 10 per cent....	6.7	8.4	5.5	5.3	1.5	3.7	5.3
Semesan Bel dip, 5 per cent.....	3.7	7.5	4.7	1.7	2.6	3.8	4.0
Semesan Bel dip, 10 per cent....	1.0	2.4	5.0	4.0	2.2	3.6	3.2
Semesan Bel dip, 5 per cent.....	0.4	2.4	4.2	3.6	4.4	7.4	3.6
Mercuric chloride	3.5	5.6	2.5	0.8	0.9	0.0	2.3
None.....	2.1	7.8	10.4	7.8	14.6	13.9	—
None.....	11.6	15.6	10.7	16.2	8.3	4.0	10.6

EXPERIMENT 4, 1926

The seed used in this experiment was a lot of Green Mountain from Maine that was refused certification because of scab and rhizoctonia tuber infection. About 50 bushels were culled over, and 450 pounds of uniformly heavily infected tubers of equal size were selected. The treatments were the same as those used in Experiment 3. The potatoes were treated April 7, cut the next day, and planted April 12. The plats were 70 feet long. Since this seed was heavily infected with rhizoctonia, a certain number of plants from each plat were dug about the time the tops were 8 inches high. Table 5 gives observations on rhizoctonia stem infection following seed treatment.

TABLE 5.—EFFECT OF SEED TREATMENT ON RHIZOCTONIA STEM INFECTION.

TREATMENT	NUMBER STEMS HEALTHY	RHIZOCTONIA INFECTION		
		Slight	Moderate	Severe
Bayer dust.....	18	8	3	6
Semesan Bel, dust.....	12	7	3	11
Semesan Bel, 10 per cent dip...	15	7	11	2
Mercuric chloride, soak.....	26	6	2	2
Check.....	7	7	6	15

The superiority of the mercuric chloride against rhizoctonia is evident from Table 5, tho the Semesan dip and the Bayer dust gave considerable control. The potatoes were dug, weighed and graded for scab and scurf infection. The results are given in Table 6.

The yield results in Table 6 show that there were slight increases from treatment with the most marked results from Semesan Bel dust

TABLE 6.—EFFECT OF SEED TREATMENT ON YIELD, 1926.

PLAT No.	TREATMENT								CHECK UNTREATED	
	Bayer dust		Semesan Bel dust		Semesan Bel 10 per cent dip		Mercuric chloride			
	Pounds	Ounces	Pounds	Ounces	Pounds	Ounces	Pounds	Ounces	Pounds	Ounces
1	56	8	84	0	80	0	82	0	63	8
2	77	8	66	0	84	0	82	0	69	0
3	58	0	73	0	76	0	71	0	62	0
4	53	8	52	4	62	0	57	0	54	12
5	66	8	64	12	72	4	65	4	74	4
6	68	0	70	12	66	4	60	4	75	4
7	55	4	56	0	66	8	57	12	58	8
8	62	4	58	8	52	8	50	4	53	12
9	78	0	73	8	74	0	82	8	63	8
10	65	8	83	8	76	0	75	0	80	8
11	79	0	74	8	73	0	75	0	60	0
12	58	8	78	8	57	0	56	0	56	8
Average	64	14	69	10	69	15	67	14	64	1

and dip. Evidently the superior control of rhizoctonia stem infection secured with mercuric chloride was not a decisive factor with respect to yield.

Scab was slight on all tubers and so the counts are given in Table 7 without dividing into grades. All treatments reduced the amount of scab with the mercuric chloride most effective.

TABLE 7.—EFFECT OF SEED TREATMENT ON PERCENTAGE OF SCAB INFECTION, 1926.

PLAT NO.	TREATMENT				CHECK, UNTREATED
	Bayer dust	Semesan Bel dust	Semesan Bel 10 per cent dip	Mercuric chloride	
1	7.3	13.1	2.5	6.4	18.9
2	6.6	11.4	1.4	5.5	17.0
3	2.6	2.7	9.0	1.4	25.0
4	14.0	8.6	6.5	4.0	14.6
5	3.0	3.9	1.4	2.0	20.9
6	5.1	9.3	2.3	4.0	15.9
7	2.7	1.1	6.8	0.0	11.0
8	6.4	6.0	4.8	6.0	22.5
9	8.0	6.3	3.7	0.3	8.2
10	3.1	5.8	7.1	3.8	20.2
11	5.7	2.5	6.6	1.1	25.0
12	6.4	6.0	4.8	6.0	22.3
Ave.	5.9	6.4	4.7	3.4	17.6

TABLE 8.—EFFECT OF SEED TREATMENT ON PERCENTAGE OF SCURF INFECTION, 1926.

PLAT NO.	TREATMENT				CHECK, UNTREATED
	Bayer dust	Semesan Bel dust	Semesan Bel 10 per cent dip	Mercuric chloride	
1	14.6	14.2	15.6	11.0	10.6
2	14.8	8.8	12.5	9.5	12.7
3	17.2	14.4	17.1	8.4	24.2
4	34.9	49.8	12.1	11.2	30.1
5	23.3	29.0	10.4	22.6	26.9
6	33.8	36.5	21.0	21.6	43.6
7	39.4	32.6	22.2	23.8	29.5
8	39.4	24.8	21.9	23.9	38.9
9	8.0	12.6	10.1	1.1	8.8
10	11.8	12.9	7.9	7.3	17.5
11	14.6	15.3	14.0	11.3	8.3
12	16.7	23.4	13.2	15.6	18.6
Ave.	22.4	22.9	14.8	13.9	22.5

There was considerable scurf infection in the crop, tho the sclerotia were not large enough to affect the grade, and counts were made as shown in Table 8. These indicate that the two dust treatments were

ineffective, while the Semesan Bel 10 per cent dip and mercuric chloride both reduced the percentage of infection.

All in all, the Semesan Bel dip gave almost as good disease control as mercuric chloride and a better yield.

EXPERIMENT 5, 1927

The seed used was as healthy and clean-appearing a lot of certified Maine Green Mountain as it was possible to find. The potatoes showed no signs of sprouting at the time they were treated, April 1, and the treatments used were as follows:

Mercuric chloride
Semesan Bel, 10 per cent water suspension, instant treatment
Bayer Dipdust, 5 per cent water suspension, instant treatment
No treatment, double lot

The seed was cut the day after it was treated and planted a week later. The treatments were replicated 10 times in 50-hill plats. The results are given in Table 9. .

The averages of the yield figures indicate that the treatments had little or no influence.

EXPERIMENT 6, 1927

The seed used in this experiment was three-fourths certified Prince Edward Island Cobblers and one fourth tubers produced by black-leg diseased plants. These latter were selected for the writer in Maine by Dr. E. S. Schultz. Lots of 80 pounds were treated on April 2, using the same treatments as in Experiment 5. The potatoes showed no signs of sprouting at the time they were treated.

The plats were kept under observation thruout the summer and the crop was excellent. The number of black-leg plants was 12 out of 2,500 hills, or about one-half of 1 per cent. Yield records are given in Table 10.

Comparing the organic mercurial instant dips with the standard mercuric chloride, it appears that they yielded distinctly better and that they also outyielded the untreated checks. There was very little to choose between Semesan and Bayer Dipdust.

EXPERIMENT 7, 1927

The material for this experiment was selected from Maine-grown Green Mountains that were refused certification because of scab.

TABLE 9.—EFFECT OF SEED TREATMENTS ON THE YIELD OF HEALTHY SEED POTATOES, 1927.

PLAT NO.	TREATMENT						CHECKS, UNTREATED			
	Mercuric chloride		Semesan Bel dip		Bayer dip					
	Pounds	Ounces	Pounds	Ounces	Pounds	Ounces	Pounds	Ounces	Pounds	Ounces
1	42	0	41	8	43	0	43	0	42	8
2	38	8	41	0	45	0	45	8	39	8
3	35	0	43	0	44	8	38	8	38	8
4	43	0	43	0	43	0	39	0	47	8
5	44	0	45	8	42	0	36	8	45	8
6	44	0	45	8	41	0	43	8	43	4
7	42	0	38	0	40	8	45	4	49	0
8	42	8	50	0	52	8	43	0	47	4
9	53	0	54	0	49	4	42	0	46	2
10	45	8	47	0	48	8	44	0	48	8
Total	429	8	448	8	449	4	417	4	447	10
Average	42	15	44	14	44	15	41	12	44	12

TABLE 10.—EFFECT OF SEED TREATMENT ON THE YIELD OF COBBLERS SUPPOSED TO CARRY BLACK-LEG INFECTION, 1927.

PLAT NO.	TREATMENT						CHECKS, UNTREATED			
	Mercuric chloride		Semesan Bel dip		Bayer dip					
	Pounds	Ounces	Pounds	Ounces	Pounds	Ounces	Pounds	Ounces	Pounds	Ounces
1	46	8	50	0	51	0	47	1	41	8
2	42	12	49	4	44	8	42	2	47	8
3	45	0	47	8	47	0	50	8	47	0
4	44	0	55	0	53	0	51	0	50	0
5	43	0	47	8	47	0	51	8	48	0
6	48	12	53	0	47	4	41	12	43	8
7	44	0	53	0	48	8	48	4	43	4
8	44	8	46	7	52	6	47	0	48	2
9	41	8	47	4	46	0	43	8	48	2
10	39	8	45	8	49	10	41	0	44	0
Total	439	8	494	7	486	4	463	11	461	0
Average	43	15	49	7	48	10	46	6	46	2

A uniform-sized, severely scabbed, 275-pound lot of tubers was selected and treatments given on April 6 as follows:

Mercuric chloride
Semesan Bel, 10 per cent instant treatment
Bayer Dipdust, 5 per cent instant treatment
No treatment

In addition there was included in this experiment a lot of seed as nearly disease free as it was possible to find. The reason for including this healthy seed check was that, while the land used had grown no potatoes for the previous five years, it had been limed in 1925, and previous experience with Long Island soils had shown that any field that had been under cultivation for many years was likely to be heavily scab infected. The natural soils are so acid that clean tubers are produced despite the presence of the scab organism, but liming, of course, changes this situation. Consequently, in this experiment it was anticipated that soil as well as seed infection would be a factor and information as to the effects of seed treatments under these conditions was desired. The potatoes were planted in the usual way in 70-foot plats.

The results given in Table 11 show that the scab infection occurred unevenly thru the soil. This is characteristic of most soil-borne disease infections. The average percentage of clean tubers from healthy seed was 38 and from scabby seed 21. From the treated lots of diseased seed the highest percentage of clean tubers was secured with Semesan Bel and, since, in previous experiments, it was abundantly proved that mercuric chloride was more effective in destroying seed-borne infection than Semesan Bel, the conclusion follows that the advantage of the latter in this test must have been due to a slight protection it gave against soil-borne scab. This would be in line with other experiments which have shown that the organic mercurials are able to exercise fungicidal action for some time after treated seed is sown, tho this action is confined to a small area immediately surrounding the seed.

The yield data are uniform for all lots, except untreated scabby seed. This outyielded untreated healthy seed and treated scabby seed. It seems very certain that the productive powers of the seed were in no way affected by the presence of scab even tho the lesions on these potatoes were so thick as to "cork" the surface of the tubers almost solidly.

TABLE 11.—EFFECT OF SEED TREATMENT ON SCAB WITH INFECTION DERIVED BOTH FROM SEED AND SOIL, 1927.

PLAT NO.	NUMBER CLEAN TUBERS	NUMBER SLIGHT SCAB TUBERS	NUMBER MODERATE SCAB TUBERS	NUMBER SEVERE SCAB TUBERS	TOTAL NUMBER TUBERS	GROSS WEIGHT IN POUNDS	AVE. WEIGHT PER PLAT TREATMENT IN POUNDS
			Mercuric Chloride				
North 1	18	119	52	37	226	85.5	
Series 2	115	115	33	37	300	78	
3	132	108	10	0	250	80	
4	188	42	1	1	232	61	
Middle 5	9	117	84	64	274	71.5	
Series 6	0	74	174	59	307	79	
7	205	57	9	5	276	66	
South 8	32	38	76	25	171	69.5	
Series 9	3	54	178	35	270	66	
10	144	80	8	0	232	53	
Totals	846	804	625	263	2,538	709.5	70.95
Per cent	33.33	31.68	24.63	10.36	100		
			Semesan Bel				
North 1	76	114	36	24	250	65	
Series 2	93	103	21	41	258	89	
3	208	51	2	2	263	78	
Middle 4	31	150	66	35	282	70.5	
Series 5	10	75	65	20	170	76	
6	210	49	1	0	260	68.5	
South 7	21	54	82	50	207	54	
Series 8	10	120	51	22	203	64.5	
9	153	100	6	7	266	59.5	
Totals	812	816	330	201	2,159	625	69.44
Per cent	37.61	37.80	15.29	9.31	100		
			Bayer Dipdust				
North 1	28	130	37	27	222	74.5	
Series 2	198	64	6	0	268	79.5	
Middle 3	69	80	195	29	373	85	
Series 4	24	84	149	39	296	79.25	
5	117	110	13	11	251	66.5	
South 6	17	137	79	38	271	71	
Series 7	6	80	85	57	228	65	
8	120	70	19	0	209	52	
9	160	87	9	0	256	61.5	
Totals	739	842	592	201	2,374	634.25	70.47
Per cent	31.13	35.47	24.94	8.47	100		

TABLE 11.—*Concluded.*

PLAT NO.	NUMBER CLEAN TUBERS	NUMBER SLIGHT SCAB TUBERS	NUMBER MODERATE SCAB TUBERS	NUMBER SEVERE SCAB TUBERS	TOTAL NUMBER TUBERS	GROSS WEIGHT IN POUNDS	AVE. WEIGHT PER PLAT TREATMENT IN POUNDS
			No Treatment (Diseased Seed)				
North 1	29	184	53	46	312	98.5	
Series 2	90	189	45	19	343	93.5	
3	135	108	37	20	300	73	
Middle 4	19	142	83	59	303	86	
Series 5	64	148	41	23	276	61	
South 6	21	74	99	37	231	71	
Series 7	58	103	22	15	198	55	
Totals	416	948	380	219	1,963	538	76.85
Per cent	21.19	48.29	19.36	11.16	100		
			No Treatment (Healthy Seed)				
North 1	108	119	48	28	303	89	
Series 2	216	76	4	0	296	84	
Middle 3	15	106	52	38	211	69.5	
Series 4	93	103	38	3	237	63.5	
5	175	9	49	0	233	56	
South 6	10	156	43	30	239	67	
Series 7	61	116	37	22	236	52	
Totals	678	685	271	121	1,755	481	68.71
Per cent	38.63	39.03	15.44	6.90	100		

EXPERIMENT 8, 1928

The seed stocks used in the three previous years carried chiefly scab and rhizoctonia infections. It was possible in the winter of 1927–28 to secure stocks showing late blight (*Phytophthora infestans* (Mont.) De Bary) tuber infection. A composite sample was made up of two-thirds Wisconsin certified seed, showing about 2 per cent of infected tubers, and one-third a brand known as Rambo's Wisconsin with 15 per cent infected tubers. Using this mixture, 70-pound lots were treated as follows:

Mercuric chloride
Bayer Dipdust, 5 per cent suspension, instant treatment, whole seed
Bayer D pdust, 5 per cent suspension, instant treatment, cut seed
Semesan Bel, 5 per cent suspension, instant treatment, whole seed

Semesan Bel, 5 per cent suspension, instant treatment, cut seed
No treatment, double size lot

The dates of treatment were March 29 and April 1, with the third and fifth treatments given two days after cutting. During the cutting, the seed pieces that showed decay were discarded, but whole tubers were not thrown away unless they were all decayed. The seed was planted April 10 in 50-hill plats 62½ feet long. The come-up was good, as the counts given in Table 12, taken a little before blossoming, show.

TABLE 12.—EFFECT OF SEED TREATMENTS OF BLIGHT INFECTED SEED ON NUMBER OF MISSING AND WEAK HILLS, 1928.

TREATMENT	NUMBER OF HILLS	PERCENTAGE OF		
		Missing	Weak	Black-leg
Mercuric chloride	500	1.6	0.8	0.0
Bayer Dip, whole seed	500	1.0	1.0	0.6
Bayer Dip, cut seed	500	1.2	0.4	0.6
Semesan Bel, whole seed	500	2.0	0.8	0.8
Semesan Bel, cut seed	500	1.2	2.2	0.6
Untreated check	1,000	2.4	2.7	1.2

The counts are so low that even the untreated seed gave practically a perfect stand, i.e., 94 per cent of vigorous plants. The mercuric chloride treatment increased this to 97.6 per cent, but this is a small gain, and obviously in this experiment the use of blight infected seed did not result in a weak stand of plants. The yields from the plats are given in Table 13. Considering these figures, it is apparent that there was little gain from treatment.

TABLE 13.—EFFECT ON YIELD IN POUNDS PER PLAT OF TREATING BLIGHT INFECTED SEED POTATOES, 1928.

PLAT NO.	TREATMENT					CHECKS, UNTREATED	
	Mercuric chloride	Bayer Dip, whole seed	Bayer Dip, cut seed	Semesan Bel, whole seed	Semesan Bel, cut seed		
1	80	71.5	79	75	65.5	66	70
2	73	75	70.5	75.5	70	68	70
3	75.5	75.5	74	81.5	67.5	67.5	67
4	71	71	78	74	73	74	78
5	74.5	75	78	72	77	74	74
6	86	72.5	87.5	85	81.5	79	82
7	84	82	86	80	84	80	81
8	83	73	86	78.5	84	78	85.5
9	85	89.5	83.5	87.5	90.5	81.5	81
10	87.5	86.5	83.5	90	90	82	84.5
Total	799.5	771.5	806.0	800.0	783.0	750.0	773.0
Ave.	80.0	77.2	80.6	80.0	78.3	75.0	77.3

EXPERIMENT 9, 1928

The experience of the previous season when potatoes from black-leg infected hills were planted and a healthy crop secured led to a repetition of this experiment. Tubers produced in black-leg hills were again selected by Dr. E. S. Schultz in Maine and shipped to Long Island. Lots of seed for treatment were made up, using 20 pounds of the black-leg stock and 40 pounds of regular Cobbler seed to each lot. These were treated March 29 as follows:

Mercuric chloride
Bayer Dipdust, 5 per cent suspension, instant treatment, whole seed
Bayer Dipdust, 5 per cent suspension, instant treatment, cut seed
No treatment

The third treatment was given two days after the seed was cut. All of the seed was planted April 10.

The growth of these Cobblers was remarkably healthy. Black-leg and missing hill counts showed that the combined figure for both was from 1 to 2 per cent with no differences between treated and untreated. On the basis of its field performance (Table 14) one would have supposed the seed used in these plats to be of the highest quality.

TABLE 14.—EFFECT ON YIELD IN POUNDS PER PLAT OF TREATING BLACK-LEG INFECTED COBBLERS, 1928.

PLAT NO.	MERCURIC CHLORIDE	BAYER DIP, WHOLE SEED	BAYER DIP, CUT SEED	CHECK, UNTREATED
1	74	84	76	75
2	72	78	80.5	72
3	68	82	73.5	84
4	72.5	74	79.5	65.5
5	72.5	65	68.5	66.5
6	83	84	84.5	69.5
7	84.5	89	81	87
8	88	94.5	88	94
9	88	83	94	91.5
10	83.5	81	88	83
Total	786	814.5	813.5	788
Average	78.6	81.5	81.4	78.8

Here again the organic mercurials show a slight increase in yield over the mercuric chloride and no treatment. The differences, however, were small.

COOPERATIVE EXPERIMENTS WITH MERCURIC CHLORIDE AND ORGANIC MERCURY INSTANT DIP TREATMENTS

The experiments previously reported were conducted with seed that in many cases would never be planted by the farmer. Also, the plats were small. To supplement this work other experiments were conducted under actual field conditions in cooperation with potato growers.

In the first year of this work, test plats were placed on the farms of G. A. Reeve, R. C. Halsey, and J. S. Ryder, the work being carried on in cooperation with the Suffolk County Farm Bureau. Mercuric chloride and Semesan treatments alike failed to increase yields in the test plats and the results of these tests were negative.

In 1926, experiments were laid out on the farms of H. J. Reeve, H. R. Talmage, Leslie Wells, and H. E. Tuthill. The plats were kept under observation the entire season and there were no measurable differences in the growth or yield.

During the season of 1927, cooperative tests were conducted by the Suffolk County Farm Bureau on the farms of J. S. Ryder and J. H. Carter. The standard mercuric chloride treatment was compared with Semesan and Bayer instant dips. There were 12 replications in the Ryder test and the average yields secured were as follows:

No treatment	203 bushels per acre
Mercuric chloride	171 bushels per acre
Semesan Bel	219 bushels per acre
Bayer Dipdust	187 bushels per acre

At the Carter farm the treatments were in duplicate with a triple check. No differences in yield were observed. Since, in the previous test, the increase with Semesan Bel and the decrease with Bayer Dip about balance one another, the results of the two tests may be regarded as negative.

Another experiment conducted on the farm of H. J. Reeve gave results as follows:

No treatment	165 bushels per acre
Mercuric chloride	174 bushels per acre
Semesan Bel	189 bushels per acre
Bayer Dipdust	174 bushels per acre

In all these tests the seed used was good sound stock that complied with certification standards. In 1927, however, the writer's

attention was called to a lot of seed which had developed blight rot so severely that when it was sorted in the spring about 50 per cent of the tubers were discarded. The sorted seed was cut and three lots of 6 bushels each measured out. The day following two were sprinkled thoroly with Semesan Bel and Bayer Dipdust, respectively, and the third lot held untreated. The seed was processed March 26 and planted April 9. Examinations made when the potatoes were breaking ground showed that many of the pieces were decaying and the stand was uneven. On July 2 stand counts were made, and yields were taken in the fall. The results are given in Table 15.

TABLE 15.—EFFECT OF TREATING BLIGHT INFECTED GREEN MOUNTAIN POTATOES, 1927.

TREATMENT	PERCENTAGE SKIPS				YIELD IN BUSHELS			
	Plat 1	Plat 2	Plat 3	Average	Plat 1	Plat 2	Plat 3	Average
Semesan Bel	33	34	32	32.3	8.5	10	8	8.3
Bayer Dipdust	12	10	9	10.3	14.5	14	14	14.2
No treatment	37	30	33	33.3	11	12	10	11

There was no noticeable difference in stand between untreated seed and Semesan Bel treated seed, but the plants in the former plats looked best and the yields indicated a similar difference. The treatment evidently was toxic which may have been due to its use on freshly cut seed. It is the only instance in the course of the four years' work where this type of seed treatment has been decidedly harmful. The Bayer Dipdust gave a substantial increase in stand and yield. It should be noted that, as recommended by the manufacturer, in 1927 the Semesan was used in 10 per cent suspension and the Bayer in 5 per cent, and since their percentages of mercury were about the same, this made the former treatment twice as strong.

In concluding the field tests with organic mercury instant dip treatments it was determined that an extensive trial of their value should be made in 1928. The work that year was carried on with the cooperation of W. G. Been of the Suffolk County Farm Bureau. Semesan Bel and Bayer Dipdust, both in 5 per cent water suspensions, were the materials used. The mixing was done at the Vegetable Research Farm and the applications were made with a compressed air sprayer using a bordeaux type nozzle. Fifteen to 20-bushel lots of seed were treated for the different growers in each case before it

TABLE 16.—COOPERATIVE POTATO SEED TREATMENT TESTS, 1928.*

PLAT NO.	VARIETY	CONDITION OF SEED				TREATMENT	YIELD IN BUSHELS PER ACRE	
		Scab	Rhizoctonia	Blight	Rot		Treated	Untreated
1	Green Mountain	slight	slight	slight	none	Dipdust	233	247
2	Green Mountain	slight	severe	none	slight	Dipdust	176	172
3	Green Mountain	moderate	slight	none	slight	Semesan Bel	268	285
4	Cobbler	slight	moderate	none	slight	Semesan Bel	285	276
7	Green Mountain	slight	slight	none	slight	Semesan Bel	214	200
8	Green Mountain	slight	slight	slight	moderate	Semesan Bel	326	322
12	Cobbler	none	none	none	slight	Dipdust	318	348
13	Green Mountain	none	severe	none	slight	Dipdust	252	250
14	Cobbler	none	slight	none	none	Dipdust	318	318
15	Green Mountain	slight	moderate	none	slight	Semesan Bel	307	295
16	Green Mountain	slight	moderate	none	slight	Semesan Bel	146	149
17	Green Mountain	slight	moderate	moderate	slight	Dipdust	227	203
19	Green Mountain	none	moderate	none	slight	Semesan Bel	183	180
20	Green Mountain	slight	slight	none	slight	Semesan Bel	294	277
21	Green Mountain	none	slight	none	slight	Dipdust	200	170
22	Green Mountain	slight	moderate	slight	slight	Semesan Bel	184	164
23	Green Mountain	none	moderate	none	slight	Semesan Bel	259	241
24	Green Mountain	none	severe	slight	slight	Semesan Bel	118	128
25	Green Mountain	slight	slight	slight	slight	Dipdust	175	180
26	Green Mountain	slight	severe	slight	slight	Semesan Bel	336	329
27	Green Mountain	none	moderate	slight	slight	Dipdust	124	115
28	Cobbler	none	severe	none	slight	Dipdust	232	189
Average							236	229

*All lots of seed certified except No. 28.

was cut. The seed used was the same that the growers were planting and two samples of 12 tubers each taken before and after treatment were later planted out at the Research Farm. The growers cooperating planted alternate rows of treated and untreated seed so as to give three replications. The yield results from the growers' tests are given in Table 16.

DISCUSSION OF RESULTS

In considering these results it will be advisible, first, to discuss the effect of the treatments on the diseases, and second, the effect on yields. The diseases considered were scab (*Actinomyces scabies* (Thaxt.) Güssow), rhizoctonia (*Corticium vagum* B. & C.), black-leg (*Bacillus atrosepticus* Van Hall), rot of seed pieces due to blight (*Phytophthora infestans* (Mont.) De Bary), and other organisms.

Disinfecting seed to destroy seed-borne scab infection was the first reason advanced for potato seed treatment and is still one of the most important. Striking results have been reported from many sections of the country. Wedgworth and Anders (20) in Mississippi found that slightly scabbed seed when planted gave only 12.35 per cent clean potatoes, while the same seed treated with mercuric chloride yielded 93.06 per cent clean tubers. Martin (13) in New Jersey reported that scabby seed, as well as giving a scabby crop, reduced the stand and yield as compared with the same seed treated. Brann and Vaughan (6) in Wisconsin, over a period of five years, secured from diseased seed crops that were from 20 to 65 per cent scabby. Mercuric chloride treatment reduced this loss to a negligible figure.

The results of our first experiment using scabby seed potatoes are given in Table 1. The untreated crop showed 37.8 per cent scabby tubers of which 23.0 per cent were slightly scabbed and salable as grade 1 potatoes, the net loss thus being 12.8 per cent. Mercuric chloride treatment reduced this loss to 0.7 per cent and Bayer and Semesan dust treatments to 3.0 and 5.0 per cent, respectively.

The results of the second experiment with scabby seed are given in Tables 3 and 4. The crop grown from untreated seed showed only 10.6 per cent scab, all of which was slight, so that the entire crop was salable as grade 1 stock. Treatments with mercuric chloride cut the percentage of slight scab to 2.3 per cent and with the dips to from 3.2 to 5.3 per cent.

The third scab experiment results are given in Table 7 and the untreated heavily scabbed seed yielded 17.6 per cent of slight scab in the crop. All the treatments, *viz.*, Bayer dust, Semesan Bel dust, Semesan Bel dip, and mercuric chloride soak, reduced the amount of disease, but the infection was so slight that this reduction meant little financially.

Each of the three previous experiments was conducted on soils with a pH around 5.2, which is normal for Long Island potato fields. The land used for the next experiment had been limed so that the reduction was about pH 6.0. The results of planting scabby seed untreated and treated in various ways and also healthy seed untreated, are given in Table 11. The crop, regardless of treatment, was heavily scabbed, including the portion grown from healthy seed. Actual counts showed that the treatments had some beneficial effect as there were 21 per cent clean potatoes in untreated scabby seed plats and 37 per cent in the best treated plats, i.e., those given Semesan Bel dip.

The outstanding fact brought out by these experiments was that the soil and not the seed was the major factor determining the amount of scab. Regardless of the amount of scab infection on the tubers, if these were planted in the normally acid soils used for potato growing on Long Island, the crop was practically clean, while if planted on land that had been limed, the crop was heavily scabbed, the main source of infection being the soil. The treatment of the seed reduced the percentage of infection but hardly sufficient to justify the bother. The dust treatments gave considerable scab control and the instant dips were almost as effective as the mercuric chloride.

These conclusions were further tested by treating scabby seed for several farmers and they could see no difference between treated and untreated in the crop dug. Incidentally, it is seldom that a Long Island potato grower has any occasion to plant scabby seed.

Rhizoctonia is universally present in all Long Island potato soils and the infection is also common on the seed potatoes. Disinfection of seed potatoes for rhizoctonia has given striking results in many localities. Richards (16), working in Utah and using rhizoctonia infected seed, was able to increase the yield as much as 50.2 per cent by mercuric chloride treatment. Raeder and Hungerford (15) in Idaho considered seed treatment for rhizoctonia profitable. Barrus and Chupp (3) in New York also recommend seed treatment for rhizoctonia.

On Long Island the potato crop matures during midsummer and the tubers are never disfigured by large black sclerotia such as develop in the cooler sections further north. The fungus is common on the stems of the plants, but despite this it rarely kills the stems or even seriously weakens them, as the usual perfect and vigorous stands of potatoes that are customary on Long Island bear testimony.

In the experiments here reported, several of the lots of potatoes used showed severe rhizoctonia infection. Thus Experiment 4 was conducted with tubers heavily infected with both rhizoctonia and scab. Counts of stem infection showed that the mercuric chloride treatment reduced the amount of this greatly, while Semesan Bel dip was not so effective and Semesan Bel dust still less so. Considering yields, however, both dust and dip plats yielded better than the mercuric chloride plats. Making counts of potatoes showing the small sclerotia, the mercuric chloride and dip treatments reduced the percentage from 22.5 to 14.8 and 13.9, respectively, but the difference meant nothing financially as all the potatoes were grade 1. Experiments with farmers have failed to show any consistent increases in the yield or quality as the result of treatment for rhizoctonia.

Black-leg is considered to be a seed-borne disease, but in Experiments 3, 6, and 9, conducted in three successive years, the planting of seed from black-leg infected fields failed to produce the disease in Long Island. In 1928, one-third of the seed tubers used were produced in diseased hills, and yet the crop grown showed only about 1 per cent of black-leg. Black-leg causes appreciable loss in occasional fields, but in none of the cooperative experiments was there any amount of this disease and consequently the results with respect to this trouble are entirely negative. It is interesting to note in this connection that Botjes (5), while establishing the seed-borne relation of black-leg, not only failed to secure control with mercuric chloride but actually found more disease in the treated seed plats.

SEED PIECE DECAY

Under Long Island conditions, when there is little rain during the weeks following planting, the seed pieces in some fields are likely to decay and this causes weak or missing hills, depending on how soon the decay destroys the seed piece. This decay is brought on by the drought combined with poor mixing of chemical fertilizers and soil. A few rains to leach out the soluble salts prevents this

trouble almost regardless of the way the fertilizer is mixed. On the other hand, fertilizer broadcast or applied in the row so that no large amount is in contact with the tubers is harmless even in dry weather. The actual agents of seed piece decay are various saprophytic organisms always abundant in soils, but these organisms rarely penetrate sound fresh seed pieces until they are rendered susceptible by the fertilizer injury. A second form of seed piece

FIG. 1.—THE SEED PIECE ATTACHED TO THE PLANT ON THE RIGHT WAS COMPLETELY DECAYED, WHILE THAT ON THE LEFT WAS SOUND.

Decay of the seed piece during the early life of the plant weakens it as shown here. Decay of the seed piece before the plant is above ground usually results in a skip.

decay is associated with late blight rot. Occasionally seed stocks are received that show up to 50 per cent of the tubers with the characteristic sunken lesions of this disease and such seed when cut and planted, often gives a poor stand due to decay. (See Figs. 1 and 2.)

In these experiments, seed piece decay of the first type was encountered several times. In Experiment 1, conducted in 1925, the protection against decay afforded by the two dust treatments and the mercuric chloride soak gave striking results. The average yield was 25.9 pounds per check plat against 62.3 pounds, 66.5 pounds, and 53.4 pounds for Bayer dust, Semesan dust, and mercuric chloride

FIG. 2.—THE MANY SKIPS AND WEAK PLANTS FOUND IN THIS FIELD WERE THE RESULT OF SEED PIECE DECAY.

FIG. 3.—ANOTHER PART OF THE SAME FIELD SHOWN IN FIG. 2, BUT WITH THE SEED TREATED BEFORE PLANTING.

Under Long Island conditions it has been found that protection against seed piece decay is the chief benefit derived from seed treatment.

soak, respectively. These treatments were applied to the seed before cutting, and yet sufficient material reached the cut surfaces to protect them, since, with untreated seed, the decay always started on the cut side. Beside these plats, planted and fertilized in the usual way, were some potatoes planted without fertilizer, and in these not a seed piece rotted. The conclusion reached as a result of the experiment was that seed treatment protected the cut surfaces sufficiently so that soil saprophytes could not enter even after these tissues had been injured and their resistence to invasion broken down by the fertilizer burning. It was noted in this experiment that the come up of the seed dusted with organic mercurials was more vigorous than that of seed soaked in bichloride, even tho the bichloride was fully as effective as the others in protecting against decay. Furthermore, the yield of the dust treated seed exceeded that of the bichloride treated. Experiment 7 was run with blight infected seed, but the come-up was good and the treatment results negative. However, in one of the cooperative tests, a blight infected seed stock yielded 14.2 bushels per plat after Bayer Dip treatment and 11 bushels per plat untreated. In this test, Semesan Bel reduced the yield.

In general, seed treatment helped prevent seed piece decay and has occasionally been very profitable on this basis. (See Fig. 3.)

EFFECT OF SEED TREATMENT ON YIELD

No claim has ever been made that either mercuric chloride or formaldehyde treatment increased yields other than thru disease control. Experimenters with the organic mercurials, however, have reported gains not correlated with disease differences. Appel (1) reported better germination and increased vigor as the result of treating with Uspulun, and he could not definitely associate these gains with disease control. Claus (8) found that potatoes treated with Uspulun powder outyielded the untreated seed and repeating the work obtained yield increases of 25 to 40 per cent. Wähling (19) observed marked stimulation of growth and earlier germination as the result of treatment.

In most of our experiments the organic mercury treated seed has outyielded the mercuric chloride treated and the untreated seed. These differences have not been attributable to disease control, since, in this respect, the mercuric chloride was superior. Whatever the reason for the increases may be, however, they were of sufficient

amount to be noticeable in the average yields of several experiments. Thus, Experiment 7 shows average yields of 43.9 pounds for mercuric chloride, 49.4 pounds for Semesan Bel, 48.5 pounds for Bayer Dip, and 46.25 pounds for untreated. These gains have not been apparent in all experiments, and in treatments tested with 28 farmers in 1928 the total increase in yield was only a little over 2 per cent. Consequently, the practical value of seed treatment as a means of increasing yields has not been proved.

CONCLUSIONS

Comparing organic mercury and mercuric chloride treatments, it appears that, in general, the organic mercury seed treatments have given the better results. They were slightly less effective against scab and were distinctly less effective against rhizoctonia, but on Long Island, owing to the general soil infection, seed treatment for these troubles is hardly worth while. The organic mercurials were effective against seed piece decay and tended to increase the yield. Their greater cost as compared to mercuric chloride was fully counterbalanced by the greater rapidity of treatment. Seed piece decay, however, is not sufficiently common to justify recommending universal seed treatment as a preventative, and the ability of any of the treatments to increase yields appreciably is very questionable. Consequently, it is concluded that, on the average, treatment with organic mercurials or with mercuric chloride is not profitable for the Long Island potato grower.

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